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Earth's Diminishing Magnetic Dipole Moment is Driving Global Carbon Dioxide Levels and Global Warming

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Abstract

Although there are powerful models that couple human activity with elevated atmospheric carbon dioxide levels and global warming, the relationships are still based upon correlations rather than causation. Consequently, there is always the probability of a third factor that produces both. Analyses of the diminishing magnetic dipole moment of the earth and the increased carbon dioxide levels and global temperature within the last 40 years revealed correlations of −0.99 and −0.90, respectively. This powerful association has been reported by other researchers. Why it has been ignored by the scientific community is not clear. The sources of the shift in average geomagnetic (magnetic dipole) intensity have not been identified but these relatively rapid decreases and increases have occurred historically with onsets of periods of warming and cooling, including glacier formation. If the long-time quasi-periodicity of the earth's magnetic dipole moment is coupled to alterations in solar activity as the system moves around the galactic center, then attribution of elevated carbon dioxide-temperature to human sources rather than actual etiologies can be counterproductive to adaptation.

Keywords

CO_2, Global Warming, Geomagnetic Field, Magnetic Dipole, Energy, Quantification

1. Introduction

The earth is a complex of spatial phenomena whose configurations vary globally and locally and whose tempor-

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al interconnections occur within seconds to centuries. The states of the gases and fluids that constitute the atmosphere and oceans are coupled ultimately to solar fluctuations but with variable latencies that produce extraordinarily complex correlations. The recent apparent coupling between positive drifting of carbon dioxide levels and global temperatures has been attributed to anthropogenic sources by various sophisticated models [1]-[3]. Pictorially, it is driven by the visually conspicuous positive correlation between global temperature and atmospheric CO_2. However, there are equally compelling and powerful quantitative associations between the recent diminishment of the earth's magnetic dipole and the increase in both global temperature and CO_2 that should be examined.

The consensus of opinion regarding the increases in global temperature as causally connected to anthropogenic sources of CO_2 is primarily based upon models rather than quantitative or multivariate analyses of actual data. Because the variables are not experimentally manipulated even a strong association is still a correlation with the possibility that a third factor produces both changes. Several authors have shown that during the same period as the slow increase in global temperature, the solar corona has expanded and related interplanetary parameters have changed [4]-[7]. The global warming apparently occurring on Mars (0.7˚C over 20 years) that is concurrent with terrestrial increases in temperature [8] is more consistent with sources within the solar system than human activities. El-Borie *et al.* [9] [10] and Persinger [11] [12] reiterated the slow increase in the amplitude of geomagnetic activity coupled to the solar coronal expansion and how quantitatively the resulting additional energy within the atmosphere and the upper layers of the oceans could elevate temperature to the values associated with global warming. Gang and Persinger [13] demonstrated the predicted effect sizes between geomagnetic activity and thermal changes in seawater within a persistently monitored locality.

However, there is still a major potential geophysical source for the carbon dioxide-global temperature connection that has been largely ignored. This is strong coupling with the recent decrease in earth's magnetic dipole moment and average geomagnetic field intensity. There is clear secular variation of the geomagnetic main field [14] which occurs within time frames of years to centuries. Courtillot *et al.* [15] reviewed the relationship among the earth's static magnetic field variations, global temperature and CO_2 concentration in the atmosphere. They noted the archaeomagnetic "jerks" or abrupt approximately 15% - 30% (~100 yr) changes in global geomagnetic intensity. Global cooling was associated with increases in geomagnetic field intensity whereas global warming was associated with decreased geomagnetic field intensity. They observed that the correlation between geomagnetic intensity and temperature disconnected after the mid 1980s when global temperature continued while solar irradiance and geomagnetic activity declined. It is important to always differentiate among changes in total magnetic dipole (geomagnetic) intensity which constitutes about 90% of the main field vs. geomagnetic *activity* that is coupled classically to primarily solar changes.

Pazur and Winklhofer [16] examined the potential source for this apparent contradiction. They found that the solubility of air in sea water was 15% lower when the average static magnetic field was 20 μT compared to the typical 50 μT. The effect upon CO_2 solubility by this magnetic effect was twice as large and sufficient to modulate the carbon exchange between the atmosphere and oceans. They estimated that a 1% decrease in the earth's magnetic dipole moment contained the potential to release the CO_2 by more than a factor of 10 compared to subaerial volcanism. Although they stated that the effect was diminutive compared to anthropogenic sources, their data indicated that only an 8% decrease in dipole moment between the years 1850 and 2000 was associated with a global temperature increase of 1.2˚C. This effectively constitutes the "global warming" around which mathematical models are constructed. Here we extend this research and show that the increase in CO_2 and decline in average geomagnetic intensity (the inference of magnetic dipole moment) are coupled so strongly. They are effective identities.

2. Data Sources and Methods of Analyses

Annual total field intensities (F) as measured in nanoTesla (nT) were retrieved from the United States Geological Survey (USGS), Boulder Observatory (BOU) (http://geomag.usgs.gov/) for the years between 1964-2012. Annual Globally Averaged CO_2 (ppm) levels were retrieved from the National Oceanic & Atmospheric Administration (NOAA) Earth System Research Laboratory (ESRL) (http://www.esrl.noaa.gov/) for the years between 1980 and 2012. The Annual Global (Land and Ocean combined) Anomalies (degrees C) expressed as departures from the 20th century average (1901-2000) measures were retrieved from the National Oceanic & Atmospheric Administration (NOAA) National Centers for Environmental Information (NCEI) (https://www.ncdc.noaa.gov/)

(formerly the National Climatic Data Center (NCDC)), for the years between 1970 and 2012.

The annual data were entered into SPSS software for investigation of statistical relationships. The BOU total field intensity measures (N = 49) had a grand annual average value of 54755.53 (±1041.25) nT, the globally averaged CO_2 measures (N = 33) had a grand annual average value of 363.56 (±16.26) ppm, and the global temperature anomalies (N = 43) had a grand annual average of 0.3344˚C (±21)˚C departures from the century average. Zero-order relationship analyses were conducted on the three annual measures.

3. Results

The results were compelling. **Figure 1** shows the relationship between the decline in average geomagnetic field intensity (dipole moment) in nT and increase in globally averaged CO_2 in ppm between the years 1970 and 2012. The scattergram showing the correlation between these two variables is shown in **Figure 2**. The correlation approaches 1 and the shared variance is effectively 100%. A ~2500 nT decrease was associated with a ~50 ppm increase in CO_2 over this period.

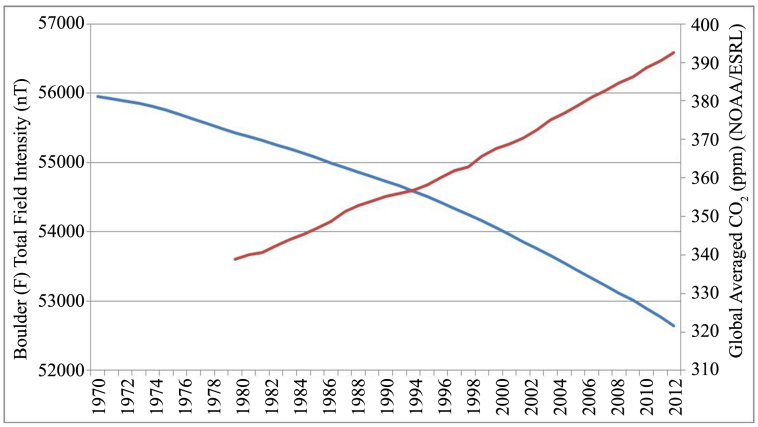

Figure 1. The decline of the intensity of the total magnetic field strength of the earth (blue line) and increase in Global Averaged carbon dioxide levels in the atmosphere.

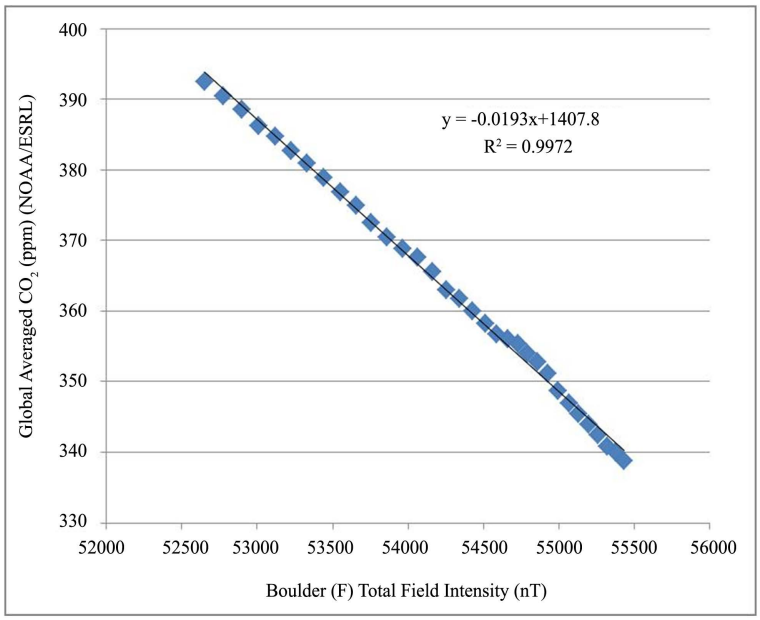

Figure 2. Correlation and regression line for the inverse correlation between the global concentrations of atmospheric carbon dioxide and the total magnetic field intensity.

Figure 3 shows the changes over time between the annual global temperature and the diminishing averaged geomagnetic field intensity. **Figure 4** shows the scattergram of the association. Approximately 82% (r = 0.91) of the variance is shared between the shift in average geomagnetic intensity and the global land and ocean temperatures.

4. Discussion and Conclusions

If changes in global temperature are like most other complex processes, there is likely to be multiple contributions that can combine and cancel in unusual or even unpredictable patterns. The reviewed consensus at present is that global warming and climate change are due almost exclusively to human activity or anthropogenic sources [1]-[3]. The conclusion leads to both geopolitical and national policy decisions that affect the perspective of billions of people, often at the expense of the full scientific method. However, despite sophisticated modeling, the causal connection between elevated CO_2 levels in the atmosphere and global warming is still a correlation. The algorithms for multiple regression models are implicitly structured such that when two variables are regressed

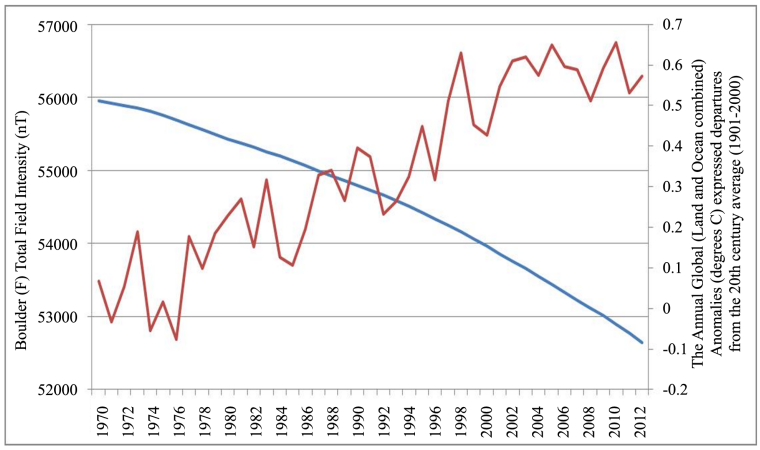

Figure 3. The decline in the earth's magnetic field intensity (blue) and increase in annual global ocean and land temperatures (red) over the last 40 years.

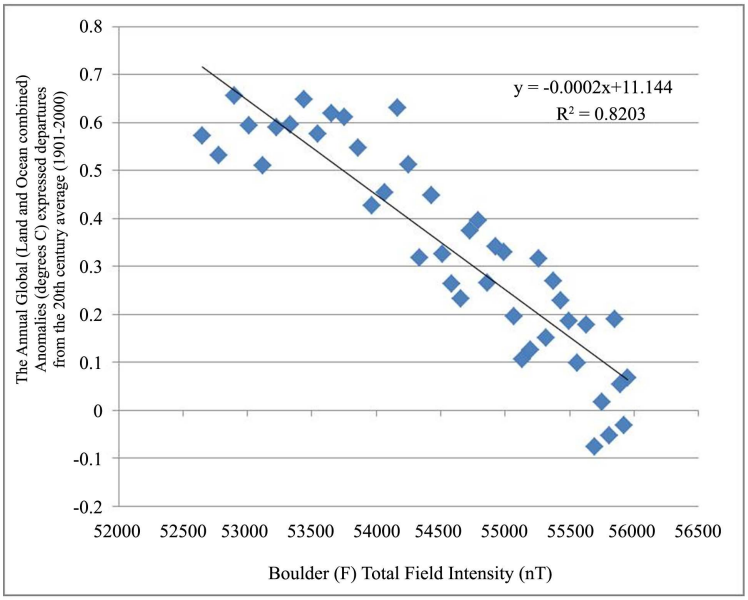

Figure 4. Scatterplot and regression line for the inverse correlation between global temperature and change in the inference of the earth's magnetic dipole.

against each other the pair with the least standard error of the estimate is often considered the causal direction. This assumes that both variables share similar numerical moments such as central tendencies, dispersions and skewness. This is not applicable to the CO_2-global temperature changes over time. The differences in the sizes of the coefficients of variation for the measures, such as CO_2 from primarily a sample of volcanic sources, compared to the global temperature estimates from a larger sample of latitude-varying stations, are significant. Hence, pictorial aesthetics more than quantitative validity often influences the viewer's interpretation of causal direction.

The limit of any correlational relationship between two variables is that there is always the probability a third variable is causing both. El-Borie and his colleagues [9] [10] and Persinger [11] [12] who examined the increasing values of the geomagnetic activity (not the earth's magnetic dipole) as inferred by the aa indices over the last century indicated that a significant proportion of increases in global temperatures could be associated with the magnetic energy available within the large terrestrial volumes. Other researchers [15] [16] have indicated as well that although consensual interpretations consider human-related origins as the major causes of global warming, there are other contributing sources. The diminishing magnetic dipole strength of the earth and the correlative increase in CO_2 release as measured experimentally by Pazur and Winklhaufer [16] have been most prominent.

Secular variation of the main magnetic field of the earth is assumed to originate from the earth's core. The origins of these changes are likely to be multivariate but coherent sources. The axial dipole moment that dominates the main geomagnetic field does not contribute, according to Ryskin's [17] elegant quantification, to the axial-dipole coefficients of secular variation. He develops the possibility that the magnetic field is induced by the electrically conductive capacity of the ocean as it flows through the earth's main field contributes to secular variation. However, the variation in ocean flow measured in Megatons per second and secular variations of 10 to 50 nT per year (between the years 1950 and 2005) was not associated with a decline in the magnetic dipole values.

To be consistent with the data from major global sources, shown in **Figures 1-4** (rather than by mathematical models), we propose that the increased atmospheric CO_2 does not cause global warming but rather both have been caused by the consequences of the diminished magnetic field strength of the earth. There is quantitative support for this suggestion. Between 1980 and 2012 the concentrations of CO_2 in the atmosphere had increased by ~50 ppm and the change in the earth's magnetic field strength had decreased by $\sim 2.9 \times 10^{-6}$ T. The traditional equation for energy from a magnetic field is:

$$E = \frac{\beta^2}{2\mu} \mathrm{m}^3 \tag{1}$$

where β is the strength of the field, μ is the magnetic susceptibility ($4\pi \times 10^{-7}$ N·A^{-2}) and m^3 is the volume. For convenience, if we assume a 10 km depth for the contributing component from the oceans and a 10 km height for the functional atmosphere, the volumes can be approximated by the differences between the earth's spherical shell radius and this 10^4 m thickness. The value would be $\sim 5.1 \times 10^{18}$ m^3. Therefore, the diminishment from a decrease of 2.9×10^{-6} T over the approximately 32 year period would be 1.72×10^{13} J.

The increase in CO_2 in the atmosphere has increased by 50 ppm or 3×10^{19} molecules per 22.7 L (a Mole, assuming STP) which is 0.13×10^{22} CO_2 molecules per cubic meter. Within the volume of the atmosphere occupied by the 10 km shell there would be 0.67×10^{40} CO_2 molecules. If the Pazur and Winklhaufer [16] data can be generalized to the global scale with respect to the differential effect of diminished magnetic field strength upon releasing CO_2 from sea water, then most of the CO_2 will originate from this source rather than exclusively human activity. Current estimates indicate that about 93% of CO_2 is contained within the oceans.

Hence, the diminished energy within the 10 km shell of sea water from the decreasing global magnetic field intensity would be 1.72×10^{13} J divided by 0.67×10^{40} CO_2 or 2.56×10^{-27} J per CO_2 molecule. The implicit assumption for J conversions is the temporal unit of one second. If we assume the weaker covalent and hydrogen bonds that sequester the CO_2 within the constituents of the sea water range between ~0.2 to 2×10^{-20} J, this means a decline of energy for about 10^{-7} to 10^{-8} s per molecule on average occurred over the total period. This duration (tens of nanoseconds) would be within the range required for CO_2 to escape the surface tension of water and for the weaker hydrogen bonds to oscillate in water. Ocean-atmosphere carbon cycle models estimate the exchange of dissolved CO_2 with equilibrium partial pressure of CO_2 in the ocean, partial pressure in the air, and the gas exchange coefficient [18]. The estimated gas exchange coefficient is dependent upon a number of envi-

ronmental variables (e.g. wind-speed) and according to the scientific literature range between 8 and 18 $mol \cdot m^{-2} \cdot yr^{-1}$. Assuming the ocean surface area of 3.35×10^{14} m^2, the 33 years for the 50 ppm CO_2 increase and the 0.67×10^{40} CO_2 molecules, there would be a net excess of +1 $mol \cdot m^{-2} \cdot yr^{-1}$ between the ocean and atmosphere carbon cycle. This value is well within the range of model-estimated variance.

If the CO_2 increases into the atmosphere from the sea water because of the diminished magnetic field are associated with the increased temperature, then that energy should translate into an equivalent temperature. Applying the classic definition that 4.18 J is required to increase 1 cc (10^{-6} m^3) of water 1˚C at STP, then the total energy within the 5.1×10^{18} m^3 will be 2.1×10^{13} J. With 1.72×10^{13} J equivalence available from the change, the analogous temperature shift will be 1.2˚C. This implies that there is an equilibrium system by which the removal of the source energy is related quantifiably to the increase or decrease of the two connected variables. Thus, the equivalent value of the 1.2˚C would be reflected in the increase due to the release of CO_2.

There is one remaining feature of the magnetic dipole moment argument that should be addressed. What would be the potential causes of this alteration? The source of the main component of the geomagnetic field is attributed to the core. However, such mass is influenced potentially by the sun's mass. In addition, the solar system is always moving through a different space around the galactic center for which the complete orbit is about 250 million years. The potential interface for which an interaction may occur that can modulate very low amplitude variations in the magnetic dipole can be considered by equating the energy associated with the main dipole moment and the change in magnetic field intensity in a volume (1) by which energy is also calculated. Hence,

$$m^3 = \left[\frac{\left(Am^2 \cdot T \right) 2\mu}{T^2} \right] \tag{2}$$

Assuming a dipole magnetic moment of 8×10^{22} $A \cdot m^2$ and the change of 2.9×10^{-6} T, the volume would be 7×10^{22} m^3. This volume would occupy about 6 earth radii. Although there are multiple events that occur at this distance, it is the minimum value for the closest approach of the compressed boundary of the magnetopause or the interface with the interplanetary magnetic field and potentially the expanding solar corona and its correlative interplanetary field [14]. Such an interface would offer an alternative explanation for the earth's magnetic dipole decline. If it is strongly coupled to the variables responsible for the expansion of the solar corona during the same period as the increase of global temperatures on earth and more recently similar elevated temperatures on Mars [8], then primary attribution of global warming to human activity rather than understanding the actual solar mechanisms may not be adaptable.

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